Assessing the Value of Intermittent Stream Temperature Data for Kings Creek at Konza Prairie Biological Station, KS.

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Introduction

Streams located in the Great Plains are essential for ecological health. Prairie streams serve multiple purposes even under constant stress. These streams are exposed to extreme heat, precipitation, harsh winters, and agricultural fragmentation. Such conditions shape the way organisms react and survive. Studying the dynamics of prairie stream characteristics can help ecologists understand the responses of prairie stream organisms to climate and habitat changes.

Objectives

Understand the effect of air temperature on stream temperature
- -Correlation
- -Lag time

Understand the effect of stream discharge on stream temperature
- -Relate stream temperature to known flood event dates

Consider other factors that can influence stream temperature
- -Riparian Vegetation
- -Groundwater
- -Precipitation
- -Sediments

Assess why stream conditions matter
- -Nutrients
- -Biodiversity

Study Site

The Konza Prairie Biological Station, located in North East Kansas (United States) is an ideal location to research intermittent prairie streams. It is located in the Flint Hills, covers part of both Riley and Geary county, and is maintained and studied by Kansas State University and the Long Term Ecological Research Network (LTER). Kings Creek is the largest of two streams that flow across the Konza, and will be the focus of this study.

This region is highly variable in both temperature and precipitation. Winter is usually dry and cold while summer is wet and warm. The average annual precipitation is 835mm. or 32.9 in. with 75% of the total precipitation falling in the growing season. The Konza is a protected native range with study areas that are minimally affected by humans outside of controlled studies, and is dominated by tall grass prairie.

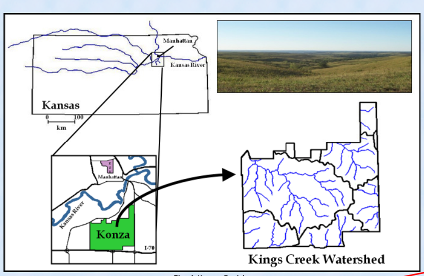


Fig. 1 Konza Prairie

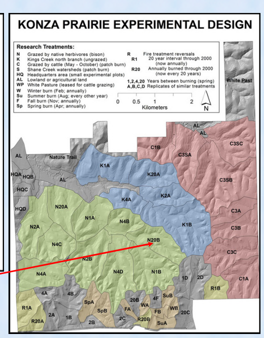


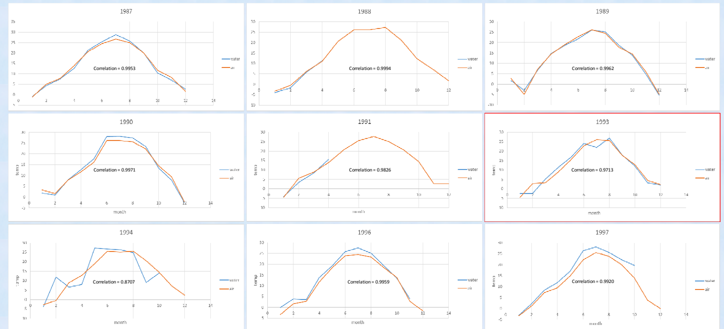
Fig. 2 Konza Prairie Watersheds

N20B Watershed
-site where stream temperature and discharge data were collected

Methods

-Stream temperature data collected from a weir placed along Kings Creek
-Air temperature data collected from online historical database for the area
-Effect of discharge assessed by checking stream temperature response to known flood event dates
-Graphs created in Excel to determine trends in temperature and discharge data over time
-Other influencing factors determined via review of published literature

Data



Figs 3-11 Graphs of monthly average stream temperature and monthly average mean air temperatures

-Strong correlation between air temperature and stream temperature data is observed in figures 3-11

-Stream temperature reached higher values than air temp, possibly due to water having a higher specific heat than air, causing less variability and larger solar radiation accumulation during months of high solar input

-No lag time in change of air temperature to change in stream temperature is observed, contrary to expectations, possibly due to lack of flow/shallow stream depth

-Stream temperature decrease is observed during the time period of known flooding, suggesting increased stream flow and discharge resulting in decreased stream temperatures (Fig. in red for 1993)

Conclusions

-With the data presented, air temperature and increased discharge/flow cannot be the sole factor controlling stream temperature throughout the year. Riparian vegetation, groundwater, precipitation, and sediment all must have their impacts well.

-Woody riparian vegetation influences stream temperature due to a shading effect (Johnson, 2004). This could affect stream temperature in one of two ways: either creating shade during the warmer months, or creating an insulating/wind block effect on a stream site resulting in higher winter and summer temperatures, as observed in the data.

-Groundwater inputs can affect stream temperature as well by providing a buffering influence on stream variations (Poole and Berman, 2001).

-Discharge and precipitation increase the volume of the stream, thereby reducing the heat energy of the water (Lauwo, 2007; Poole and Berman, 2001).

-Increased stream temperatures could be indicative of high sediment load in the stream body (Kaushal, 2013; Poole and Berman, 2001).

-All of these factors have implications for stream quality. These factors contribute to the moderation of nutrients, especially Nitrogen, within the stream via decay rates, runoff, etc. (Craine, 2011; Tate and Gurtz, 1986) as well as biodiversity based on nutrient availability and stream connectivity at any given time as determined by flow rate.

-Suggested future topics of study involving this stream temperature data set should include the effects of riparian woody vegetation clear-cutting on stream temperature, assessment of groundwater influence in each watershed along Kings Creek, and assessing data for the temperature changes at different scales to investigate which scale demonstrates the relationship between air temperature and stream temperature the best (daily vs. weekly vs. monthly).

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